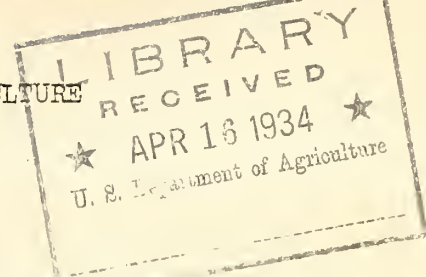


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UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Biological SurveyLUNGWORM TROUBLE IN FOXES--ITS TREATMENT AND CONTROL

By Karl B. Hanson, U. S. Fur-Animal Experiment Station, Saratoga Springs, N. Y.
Division of Fur Resources

Lungworm trouble is one of the most important diseases of the fox-breeding industry. Each year its prevalence is steadily increasing, both in the number of ranches involved and in the relative number of serious cases of the disease on affected ranches. Because of its insidious and chronic nature, fox farmers usually do not give lungworm trouble much attention until after it has become well established and has developed to be a permanent handicap to the most successful operation of their ranches.

Cause and Modes of Transmission

The lungworm most commonly found on fox farms in this country (Capillaria aerophila) is a white, slender worm, varying from 1 to 3 inches in length. It is usually present in the windpipe and its branches.

The worm is transmitted through eggs, which, after being raised from the lungs, are usually swallowed and then passed in the feces. With suitable moisture and temperature conditions the eggs undergo an incubation in which the embryo worm is developed within the shell. It is believed that foxes pick up this parasite in eating or licking substances or objects that are contaminated with the embryonated eggs. Through one means or another the eggs hatch and the larval worms eventually reach the air passages of the lungs, where they remain and grow.

Occurrence

Lungworms are more troublesome on old ranches than on new ones, largely because of the gradual accumulation of embryonated eggs in the pen soil. Occasionally, however, they may be exceedingly troublesome on ranches that have been in operation for only a couple of years. In such cases there usually is a history of bad rattlers, wheezers, or coughers that have been allowed to stay in the regular breeding pens instead of being moved promptly and kept in isolated quarters where they can not contaminate ground occupied by healthy foxes.

Poor drainage, wet weather, heavy soil, and shade tend to favor incubation of the eggs and are, therefore, conducive to the development of the parasite. As a general rule, lungworms are not troublesome on unshaded and well-drained ranches with a sandy soil or on those where the foxes are kept in clean and properly drained concrete or board-floor pens.

In our northern climate cases of lungworm-trouble rarely develop after freezing weather sets in. In fact, most foxes having the disease

recover from both symptoms and infestation during the winter, particularly if it is a cold one with a heavy snowfall and a little thawing weather. Nevertheless, after the snow melts in the spring, the foxes again start picking up lungworms. Thus, this parasitic disease tends to run a seasonal cycle in the northern parts of the United States, the foxes picking up infestation and developing symptoms in spring and summer and early in fall and then recovering during winter.

Symptoms

Foxes lightly infested with lungworms, and even some of those moderately infested, usually show no noticeable symptoms. In some of the moderate and practically all of the heavy infestations, however, symptoms become apparent, consisting usually of one or more of the following: A wheeze, a rattle, rales, short-wind, or spawl of a deep husky or hacking cough. Since chasing and catching the animals tend to bring out these symptoms and make them more noticeable, this method is often taken advantage of as an aid in the detection of affected animals. In bad cases one or more of the following may also become manifest: Emaciation, anemia, weakness, discharge from the nose and sometimes the eyes, and an unthrifty pelt.

In most cases lungworm trouble tends to be chronic and insidious in nature, the symptoms developing gradually and remaining about the same for a few weeks to several months. Except in bad cases the animals seldom show marked distress or loss of appetite.

Acute cases, or those that develop rapidly and soon terminate in death, are occasionally encountered. In such instances there generally is evolved either a heavy infestation picked up within a short time or a complicating bacterial infection.

Lesions

Light and moderate infestations usually are associated with no apparent gross lesions. Chronic catarrhal inflammation of the windpipe and its branches, together with more or less abundant phlegm-like exudate in the air passages, is encountered in some moderate and nearly all heavy infestations. It is this exudate that is responsible for the characteristic wheeze or rattle so common in lungworm trouble. Chronic bronchial pneumonia is rather common in bad cases of long standing. The inflammation and the symptoms produced by the lungworms may persist for some time after the animal has recovered from infestation.

Care and Treatment of Pens

The droppings (manure) of all foxes should be picked up thoroughly and safely disposed of each day throughout the year. This is essential to help reduce contamination of the ground and prevent the pens from becoming a troublesome source of worm infestation. Pens should be well drained. It is advisable to have drainage ditches around every pen so as

to prevent the dissemination of lungworm eggs by water flowing from one pen into another. Heavily infested foxes or those showing apparent symptoms of lungworm trouble should not be allowed to remain in breeding pens any longer than is absolutely essential. Such animals should be promptly removed to isolated quarantine pens, where they will not have opportunity to infest ground that is used by healthy stock. It requires only a short time for a heavily infested fox so to contaminate a pen that practically all susceptible animals kept in it will likewise become heavily infested with lungworms.

Once a pen becomes a troublesome source of lungworm trouble, it is advisable to abandon it until after it is given a treatment that will remove or destroy the major portion of the infective lungworm eggs. In the light of present knowledge the following appear to be the most satisfactory methods of treating badly infested pens:

1. Moving the pen to well-drained virgin soil, preferably sand.
2. Removing the top 3-inch layer of old soil, safely disposing of it, and then replacing it with clean sand or fine gravel.

If conditions preclude either of these, then heating the ground thoroughly with a large torch, boiling water, or steam might be tried. In these treatments it is essential that the ground be heated well to a depth of at least two inches, and to accomplish this is considerably more of a task than most persons would believe. Leaving troublesome pens unoccupied over winter or for a year appears to be an ineffective method of treatment.

Treatment of Foxes with Lungworm Trouble

Whenever a fox develops the slightest wheeze, rattle, or other evidence of lungworm infestation, it should be promptly moved to clean and dry quarters, where the picking up of infective lungworm eggs will be reduced below the danger point. The animal should be kept in such quarters until after it has made a complete recovery. It is important that patients be taken out of badly infested pens as soon as possible, because the sooner the picking up of lungworms is stopped the better are the chances of recovery. Satisfactory types of hospital pens for foxes undergoing treatment are as follows:

1. Self-cleaning pens provided with heavy-gage 1-inch-mesh wire floors set about 18 inches above ground.
2. Concrete, asphalt, or board-floor pens that are well drained and so made that they can be readily and effectively cleaned.

3. Earth bottom pens placed on well-drained virgin soil preferably sand, or where the old contaminated soil has been removed, safely disposed of, and replaced with clean sand or fine gravel.

The hospital pens should be no less than 12 feet long and 6 feet wide; otherwise the patients will not be afforded a fair chance of keeping in good condition, much less recovering from the ill effects of lungworms. It is important also that they be kept scrupulously clean, particularly as regards fecal material. All manure should be thoroughly cleaned up each day and safely disposed of. During freezing weather earth-bottom hospital pens should, at monthly intervals, be moved to clean ground or the soil in them changed.

The patients should be placed on a palatable and nutritious diet and fed liberally. Good feeding is essential to building up resistance. Apparently no one has yet succeeded in finding a drug that is both safe and effective against lungworms in foxes or any other animals. Every now and then there are persons who claim to have discovered such a remedy, but thorough investigation invariably has demonstrated that these remedies are either ineffective or more injurious to the patient than to the parasite. Some of the so-called lungworm medicines sold for the treatment of foxes, as well as some that have been recommended for the treatment of other kinds of animals, have been tested at the U. S. Fur-Animal Experiment Station, and without exception all were found ineffective against lungworms in foxes. Moreover, the injection of drugs into the windpipe or lungs is an exceedingly dangerous measure and is to be avoided by the average fox farmer.

Within the past few years there have come on the market two distinct types of tracheal swabs for the treatment of lungworm-infested foxes. The first of these is a rather crude and unsatisfactory outfit consisting of a heavy and long-galvanized-wire handle on the end of which is fastened a small piece of sponge. This swab is passed down the windpipe through a small piece of rubber tubing and the windpipe swabbed out with the soonge.

The other device is really a combination tracheal syringe and tracheal swab, the latter having a sponge-capped brush on its end. When this instrument has been passed down the windpipe, the plunger of the syringe is inserted so as to protrude the brush from the thimble-like structure on the end of the long syringe-nozzle, as well as to inject simultaneously a liquid preparation into the lungs. Extensive tests have been made at the Experiment Station of this instrument. Findings indicated that it possesses one feature of considerable value in the diagnosis and treatment of lungworm infestation in foxes, in that the brush portion of the swab usually removes practically all the lungworms it reaches. In critical tests on 10 foxes that were killed 12 to 24 hours after treatment, the brush removed 116 (33.4 percent) of the 302 lungworms present in the windpipe, bronchi, and bronchioles. There were only 24 worms left in the windpipe, all of these being in three particularly long-bodied animals in which the instrument failed to reach to the farthest end of the windpipe.

Observations indicate that the common lungworms of foxes tend to work gradually up into the windpipe from the air passages in the lungs. For this reason, the periodic treatment of foxes, at intervals of ten days to two weeks, eventually removes all lungworms present, provided reinfestation is effectively prevented.

Clinical tests of the instrument have yielded encouraging results. Although the judicious use of tracheal swab at intervals of two weeks appears greatly to hasten recovery of patients, such treatment is not of much value if the patients are allowed to stay on badly infested ground. Best results are obtained when the instrument is used as a supplement to good feeding, care, and sanitation.

The passage of tracheal swabs is a delicate surgical operation attended with great danger unless certain important surgical and sanitary precautions are observed. For this reason, it is strongly advised that the use of one of these instruments be undertaken only by a competent and skilled veterinarian who has had considerable experience in the use of either tracheal swabs or bronchoscopic instruments. Some of the precautions advised in the use of tracheal swabs on foxes are as follows:

1. Perform the operation under as sanitary conditions as possible, preferably in a clean operating room where both hot and cold running water are available.
2. Thoroughly clean and sterilize the entire instrument before using, as well as between each successive patient.
3. Provide a separate brush for each patient.
4. Soften the brushes by soaking them in boiling water for at least 15 minutes just before using.
5. Pass and withdraw the instrument slowly and very gently; never use force.
6. Do not treat a patient oftener than once a week.
7. Use a good speculum and be sure that the animal is well restrained while the instrument is being passed.

The treatment of lungworm trouble in foxes is a matter requiring considerable time, patience, and close attention to details of sanitation. Although some patients may show marked improvement within a couple of weeks after being treated with a tracheal swab and placed in special sanitary quarters, it usually requires from one to three months to cure completely a rattler or wheezer, if treatment is undertaken before the condition of the patient has become too serious.

Fox farmers who have never had lungworm trouble on their ranches should be on guard to prevent it, for the disease is an especially difficult one to control and may recur year after year once it becomes established.

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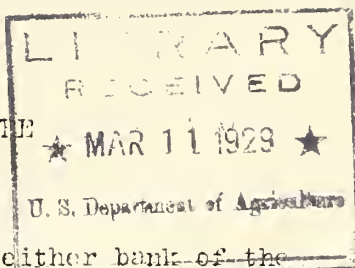


Table showing the hours of sunset and sunrise on either bank of the Mississippi River where it passes within the area of the Upper Mississippi River Wild Life and Fish Refuge, extending from Rock Island, Illinois, to Wabasha, Minnesota.

Davenport, Iowa.

Day	Sunrise		Sunset	
	March	April	March	April
	A.M.		P.M.	
1	6:38	5:45	5:53	6:28
2	:36	:44	:54	:29
3	:35	:42	:55	:30
4	:33	:41	:57	:31
5	:31	:39	:58	:33
6	:30	:37	:59	:34
7	:28	:35	6:00	:35
8	:26	:34	:01	:36
9	:25	:32	:02	:37
10	:23	:30	:04	:38
11	:21		:05	
12	:20		:06	
13	:18		:07	
14	:16		:08	
15	:15		:09	
16	:13		:10	
17	:11		:11	
18	:10		:13	
19	:08		:14	
20	:06		:15	
21	:05		:16	
22	:03		:17	
23	:01		:18	
24	5:59		:19	
25	:58		:20	
26	:56		:21	
27	:54		:23	
28	:53		:24	
29	:51		:25	
30	:49		:26	
31	:47		:27	

Wabasha, Minnesota.

Day	Sunrise		Sunset	
	March	April	March	April
	A.M.		P.M.	
1	6:45	5:49	5:56	6:35
2	:43	:47	:57	:36
3	:42	:46	:58	:37
4	:40	:44	6:00	:38
5	:38	:42	:01	:40
6	:36	:40	:03	:41
7	:34	:38	:04	:42
8	:33	:37	:05	:43
9	:31	:35	:06	:44
10	:29	:33	:08	:45
11	:27		:09	
12	:26		:10	
13	:24		:12	
14	:22		:13	
15	:20		:14	
16	:18		:15	
17	:16		:16	
18	:15		:18	
19	:13		:19	
20	:11		:20	
21	:09		:21	
22	:07		:22	
23	:06		:24	
24	:04		:25	
25	:02		:26	
26	6:00		:27	
27	5:58		:29	
28	:56		:30	
29	:55		:31	
30	:53		:32	
31	:51		:33	

From Davenport, Iowa, and Rock Island, Illinois, to Blake, Wisconsin, use the Davenport table.

From Blake, Wisconsin, to Wabasha, Minnesota, use the Wabasha table.

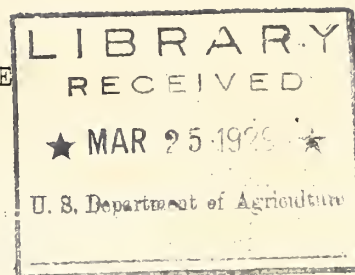
Above Blake, Wisconsin, to LaCrosse, Wisconsin, subtract 3 minutes from the Wabasha table.

Above LaCrosse, Wisconsin, to Winona, Minnesota, subtract 2 minutes from the Wabasha table.

Above Winona, Minnesota, to Wabasha, Minnesota, use Wabasha table.

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY

Reindeer Experiment Station
College, Alaska



REDUCTION OF WARBLE AND NOSE GRUBS IN REINDEER

Warble and nose-grub infestation in reindeer may be greatly lessened by a general application of the methods described below, in concerted action on the part of reindeer owners.

Life History of Warble and Nose Flies

Investigations disclose the following pertinent information regarding the life history of the warble and nose flies responsible for the grubs in reindeer:

Stage	Warble Fly	Nose Fly
1. Period of emergence of grubs	April 22 to June 22 (2 months)	April 22 to June 7 (1 1/2 months)
2. Greatest emergence of grubs	Latter part of May	Middle to latter part of May
3. Pupal stage	24 to 37 days; average, 1 month	16 to 37 days; average, 25 days
4. Period of emergence of flies	June 25 to July 25 (1 month)	June 15 to July 25 (1 1/3 months)
5. Greatest emergence of flies	First half of July	Latter part of June
6. Life of fly	Female, 4 to 6 days; male, 6 to 9 days	10 to 13 days

Method of Control

From the foregoing it will be noted that in the case of the warble the last dropping of grubs merges with the first appearance of the fly on about June 25, and in the case of the nose grub on about June 15. This then suggests a definite period for controlling them. The flies are short lived and do not travel any great distance; therefore if the herd is moved away from the area where grubs have been dropped prior to any considerable hatching of flies, a method of escape is had. The period of emergence of the flies of both the nose grub and the warble grub ends about July 25. Consequently, the herd must be held away from the infested area during this time and long enough in addition to insure that the last fly has died, or until the first part of August. The time of emergence of grubs is during the reindeer fawning season, April 15 to June 20. The herd at this time should be closely confined to a definite small area in order to have all the grubs drop in this one place. This area should be

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located at least 15 miles from the corral site and early summer range and should be used each year only during the two months of fawning and dropping of grubs. Preferably this location should be inland from the coast, bordering the winter range, so that the grubs will be dropped away from the summer range of one's own herd as well as that of adjoining herds. At the end of the spring period, that is, June 20, which^{is} also the date for beginning the summer round-ups, the herd should be promptly moved at least 15 miles away to the coast for corralling and summer pasturing. Here they should be held at least 1 1/2 months, or until about August 10.

Schedule of Handling

To fix these dates firmly in mind, they may be stated again briefly as follows:

April 15 to June 20.--Hold herd on restricted spring range for dropping grubs.

June 20 to 25.--Move herd 15 to 20 miles away for summer pasturing and for corralling.

June 25 to August 10.--Keep herd 15 to 20 miles away from grub and fly infested area.

Importance of Fawning-Ground Location

It is important that the herd be moved far enough away, not only from its own fawning ground but also from that of adjoining herds, to obtain complete protection. Along the coast this will usually necessitate holding the herd 15 to 20 miles inland from the coast for fawning, instead of bringing them to the coast as formerly. In selecting the spring range, it might be well for owners of adjoining herds to plan their layouts together and perhaps choose adjoining localities. This will tend to concentrate the infestation and to insure that, when leaving one grub area, the reindeer will not be approaching another on an adjoining range.

Salting as an Aid to Holding the Herd

Salting the fawning ground is suggested as an aid to holding the herd inland. Salt is particularly desired by the reindeer in spring and should therefore prove an inducement for them to remain in the locality. About 1 pound of salt for each animal would be required during the spring period. This salt should be delivered to the area by reindeer or dog sled during winter.

Value of Eradication

Efforts to reduce the number of warble and nose grubs in reindeer will be amply repaid in better condition of animals and production of cleaner hides. Reindeer hides, if free from grub holes, have considerable market value. Irritation of the animal by the presence of flies and grubs results in loss of weight. Remove this irritation and the animal will gain rapidly in weight and produce better meat.